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IDENTIFYING METHODS OF GATHERING AND SHARING HAZARDOUS AIR CONTAMINANT INFORMATION

by

James S. Schultz

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Investigation Advisor

The Graduate School
University of Wisconsin-Stout
December, 2000

The Graduate School
University of Wisconsin-Stout
Menomonie, WI 54751

ABSTRACT

	Schultz	James	S.
(Writer)	(Last Name)	(First)	(Initial)

IDENTIFYING METHODS OF GATHERING AND SHARING
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For the past five years, air contaminants at Spectro Alloys have been a major source of employee concern. In these same five years, Spectro Alloys has seen high turnover and low employee morale. The purpose of this study was to assess and describe ways in which organizational trust-building can be enhanced by identifying effective methods of gathering and sharing information related to occupational exposure to air contaminants at Spectro Alloys Corporation. Based on employee feedback and past air sampling data, the two major air contaminants at Spectro Alloys are hydrogen chloride and aluminum dust. For this study, the health hazards associated with aluminum and hydrogen chloride were researched. Additionally, the value of trust in organizations, and methods of health hazard communication were described.

Air sampling performed at processes associated with high levels of air contaminants showed results to be acceptable compared to OSHA's Permissible

Exposure Limits. The information was shared with employees, supervisors and management for the purpose of pre-testing material, soliciting feedback and gaining participation in the process from all levels of Spectro employees. The information sharing sessions concentrated on the material, its health hazards, signs and symptoms of exposure, permissible exposure limits, concentrations found at Spectro, and controls associated with reducing employee exposure to the contaminants studied.

Methods of gathering and sharing information included personal communication, literature reviews, air sampling and the creation of materials with which to share the air contaminant information in an effective manner. Informal feedback from employees showed that trust, which is based on the relationship between the source and the recipient of the message, will take time to build Spectro Alloys. Effective information sharing methods, combined with air sampling data gives Spectro Alloys management an opportunity to begin trust-building and create a more favorable relationship with its employees.

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Chapter 1

Statement of the Problem

Introduction

Spectro Alloys Corporation, an aluminum recycling plant located in Rosemount, Minnesota, has been in existence for over 25 years. Spectro Alloys buys aluminum scrap, remelts and refines it into ingot or sow for the aluminum die cast industry. In 1994, Spectro instituted a continuous process in their operation which drastically improved production, making them one of the top five American suppliers of secondary aluminum - over 150 million pounds were shipped in 1999. An employer of approximately 100 employees, Spectro's workforce is predominantly male (6 women are office workers). The company operates twenty four hours per day, seven days per week, with employees working 12 hour shifts. Because the work environment is harsh and the job itself is physically demanding, employee retention and hiring of permanent workers has been difficult the past five years. In 1999, 25 full time workers left Spectro. That same year, more than 100 temporary employees were brought in to fill out the roster. As a result of such turnover, efforts in the area of safety and training have been primarily devoted to new employee orientation.

The plant consists of two large furnaces, a shredder and drier system, baghouse and cyclone dust collection systems, a chlorine distribution plant, and various maintenance, engineering and administrative quarters. There are several openings in the buildings that allow large scrap-hauling equipment to enter and exit. The openness of Spectro provides ventilation, while at the same time has made it particularly vulnerable to the elements. Historically, the baghouse has been unable to capture all of the smoke from the smelting furnaces, resulting in "fugitive smoke" lingering in the work area. In addition to the smoke, Spectro employees are able to see particles of aluminum and dirt suspended in the air and periodically smell the hydrogen chloride in the smoke emitting from the furnaces and aluminum dross.

The work atmosphere is somewhat dark and is often filled with distinct and sometimes noxious odors resulting from smoke at the furnaces, diesel powered equipment and the continuous chlorination involved in the production of recycled aluminum. With the exception of some spray paint on the walls, the majority of the concrete block walls are not painted. Due to an assault of acidic smoke, the steel beams, roof joists and much of the electrical conduit and piping is corroded. It has often been stated at Spectro Alloys, "if it does that to steel, what is it doing to me?"

Questions similar to the one previously stated are not irrational or unfair for an employee to ask their employer. Such questions have not been answered in a satisfactory way, making employees skeptical of the minimal amount of information given. The OSHA Hazard Communication Standard provides an employee the right to know answers to such questions. In fact, the standard requires the employer to provide information prior to the employee working in a new environment. The lack of information regarding employee exposure is not only discouraging to those who want answers, but also a violation of an OSHA standard. If there is exposure causing sickness, consequently loss, it's not good business either! At Spectro, a strategy for gathering and sharing information related to air quality appears essential.

Purpose of the Study

The purpose of this study is to assess and describe ways in which organizational trust-building can be enhanced by identifying effective methods of gathering and sharing information related to occupational exposure to air contaminants at Spectro Alloys Corporation.

Goals of the Study

1. Identify hazardous air contaminants at Spectro Alloys Corporation

1.1 Measure air contaminant levels to assess risk

2. Identify methods to effectively share information related to air contaminants and associated risks

Background and Significance

The present director of Safety and Training performed air sampling in October, 1997 at a furnace area that repeatedly prompted employee complaints. The area was very smoky and dusty. In addition to the furnace, there is a conveyor system in this building that dumps dried turnings and other shredded scrap into bins and into the furnace. Turnings are scrap aluminum that look like shavings or grindings from a drill press or punch. When turnings are crushed and dried, the result is a fine aluminum scrap that includes aluminum dust, and a lot of what is classified as nuisance dust. The floor in the area sampled is generally covered with a layer of dust and dirt. The person working in the sampling area gets particulate matter from the conveyor on their work clothes. To the worker, the very visible dirt and aluminum dust on the floor leaves a distinct visual image that is clearly less than desirable in their mind.

After sampling was completed, results showed total particulate levels to be .19 mg/m3, which were low compared to OSHA's permissible exposure limit of 15 mg/m3 (U.S. Department of Health and Human Services, 1997) for aluminum. These findings were shared with all employees at a safety meeting in November of 1997. The sampling information was met with derision and skepticism. A furnace worker wryly said, "Don't tell me what's in the air, just tell me how long I've got!"

On December 3, 1997, OSHA came to the facility to conduct a "Minnesota First" inspection (not at all like the name infers - Minnesota First was a new OSHA initiative that identified the 100 companies with the worst injury records in the state.) Spectro passed the inspection with no fines and no citations. Air monitoring results from a previous OSHA inspection (July, 1992), which showed results well below the permissible exposure limits for aluminum (.106 mg/m3 - OSHA PEL 15 mg/m3 [USDHHS, 1997]), were acceptable to the industrial hygienist from the Minnesota First inspection team. Spectro employees were not impressed, as surveys showed that air quality issues were a main concern and that they still believed the air was harmful to their health.

Thus, a big problem at Spectro Alloys is trust. Even with an OSHA inspection resulting in no fines and citations, and air sampling data to show that air contaminant levels have been within acceptable limits, there is still a feeling among employees that the air is not safe to breathe. The following is Spectro's mission statement, found in the Employee Handbook:

> "Spectro Alloys Corporation, a manufacturer and broker of aluminum alloys, is a low-cost producer of quality aluminum, with a focus as a team, to be leaders with integrity, and innovators, responsive to our customers, suppliers, ourselves, our environment and our country."

Spectro employees' history of low trust is in part related to their cynical view of the mission statement's references to Spectro being a leader with integrity, and being responsive to ourselves and our environment when air quality, in the their mind, was less than acceptable.

One of the major reasons there is a low-trust culture is that Spectro has been very poor at gathering and sharing information. Whether it is chemical properties of chlorine or the effects of tight margins in the market, information has not been gathered and shared in a way that that would enhance the employee-management relationship at Spectro.

Information related to employee exposure to air contaminants and the accompanying health effects is technical in nature. In addition, there is often conflicting data and misconceptions about the effects of certain materials. Spectro has not created a strategy with which to identify exposures and educate employees about air contaminants. Information which has been gathered and shared has been put forth in a less than acceptable manner, since the topic of poor air quality and perceived health effects continues to concern Spectro employees.

Limitations

1. This study is limited to Spectro Alloys Corporation.

Definition of Terms

ACGIH - American Conference of Governmental Industrial Hygienists. Agency which recommends workplace exposure limits for hazardous substances.

Aluminum dross - Dirt and aluminum oxide skimmed off the metal bath during the smelting process.

Carcinogenic - Cancer causing.
Ingot **-** Product shape used in the metal industry; similar to a gold bar.

Metal fume fever - A flu-like condition caused by inhaling heated metal fumes.

Milligrams per cubic meter (mg/m3) - unit used to measure air concentrations of dusts, gases, mists and fumes.

Neurotoxin - A substance that is poisonous or destructive to nerve tissue.

Parts per million (ppm) - Parts of vapor or gas per million parts of contaminated air by volume.

Pneumoconiosis - Any lung disease due to permanent deposition of substantial amounts of particulate matter in the lungs.

Pulmonary Fibrosis - Chronic inflammation and progressive fibrosis of the pulmonary alveolar walls.

Respiratory System - Consists of the nose, mouth, nasal passages, nasal pharynx, larynx, trachea, bronchi, bronchioles, air sacs (alveoli) of the lungs, and muscles of respiration.

Smoke - An air suspension (aerosol) of particles originating from combustion or sublimation; generally contains droplets as well as dry particles.

Sow - Large product shape produced in the aluminum industry; approximately 1000 pounds.

TLV - Threshold Limit Value. A time-weighted average concentration under which most people can work consistently for 8 hours a day, day after day, with no harmful effects. A table of these values and accompanying precautions is published annually by the American Conference of Governmental Industrial Hygienists.

Chapter 2

Review of Literature

Introduction

The review of related literature is a combination of research gained from periodicals, journals and books associated with the contaminants -- aluminum and hydrogen chloride; the value of trust in organizations; and the process of sharing health related information. Additional resources used in the literature review include personal communications with industrial hygiene professionals and past air sampling data.

Exposure to Aluminum

Aluminum, the most abundant metal on earth, is found in soil, in water and in air. Its chemical and physical properties make it ideal for a wide variety of uses. Although it is primarily used in the container and packaging industry, aluminum is also used widely in construction and the automotive industry. It can also be found in food additives, drugs, consumer products like cooking utensils and aluminum foil, and in water treatment. Since aluminum is so common in everyday life, it is almost impossible to avoid exposure to it. According to Patty's Industrial Hygiene and Toxicology (Beliles, 1994), the average human daily intake of aluminum is 36.4 mg, which ranks second only to magnesium. Aluminum is absorbed into the body by inhalation and ingestion. Following absorption, which is usually less than 1% of total aluminum intake, it is stored in at least three main body divisions; the soft tissues and the skeleton and lungs (U.S. Department of Health and Human Services, 1995). Removal from the soft tissues takes place in a few hours or a few days. Removal from the skeleton and lungs may take months or years. It is believed that aluminum, which accumulates in the brain, cannot be eliminated (Beliles, 1994).

Historically, aluminum has been viewed as relatively nontoxic. A toxicological profile for aluminum published by the U.S. Department of Health and Human Services provides a “Public Health Statement" that states, “We do not know of any humans who have died or have gotten cancer from aluminum” (U.S. Department of Health and Human Services, 1992). It should be noted, however, that over the years, there have been several studies involving the health effects of aluminum, and that many questions pertaining to the risks associated with aluminum exposure have arisen. Studies included in this literature review are related to employee exposure and include aluminum's effects on the brain, the respiratory system and its association with cancer.

Information concerning exposure to aluminum can be confusing. In the past twenty years, one of the most prominent issues regarding aluminum has been its association with neurological disorders, most notably, Alzheimer’s. A web site devoted to the disease, Alzheimers.com, lists exposure to aluminum as a “controversial risk factor” that has not been proven, yet has been commonly blamed for the disease. (www.alzheimers.com, Nov. 2000). Another controversial issue involving aluminum is its effect on respiratory disease. There have been cases of deaths purportedly due to aluminum inhalation and even a disease associated to the metal, named Shaver’s Disease. This disease is attributed to Dr. Charles Shaver who investigated pulmonary changes in employees working in the aluminum industry in the 1950's. On the other hand, there is an ongoing experiment involving over 30 years of aluminum exposure where miners in

Canada actually inhaled finely ground aluminum as a prophylactic to protect them from exposure to silica (Proctor, 1991).

A fact sheet published by the Agency for Toxic Substances and Disease Registry (ATSDR, 1995) states that, “everyone is exposed to low levels of aluminum from food, air and water...exposure to high levels of aluminum affects breathing, the nervous system, and bones...high levels can also cause birth defects.” A hazardous substance fact sheet, published in 1994 by the New Jersey Department of Health and Senior Services, states that, “aluminum can cause metal fume fever” and that “exposure to fine dust can cause scarring of the lungs (pulmonary fibrosis).” A Material Safety Data Sheet (MSDS) prepared by Reynolds Aluminum in 1990 states that aluminum dust is considered a nuisance particulate, with no known effects of chronic exposure. The American College of Governmental Industrial Hygienist's (ACGIH) Threshold Limit Values and Biological Exposure Indices (TLVs & BEIs;1997) lists aluminum as an inert or nuisance dust, while also listing it as an "A4 Carcinogen," meaning there is speculation about cancer and its relationship to aluminum, but not enough data to support or refute claims of carcinogenicity at this time. Examples like these show that data pertaining to the health effects of aluminum exposure can be confusing to the interested employee and even the person responsible for interpreting and sharing information related to health hazards associated with aluminum exposure.

Aluminum and Neurological Disorders

In a study involving the effects of aluminum on the nervous system (Sjogren, et al. 1996), questionnaires, psychological tests and neurophysiological methods were administered to a test group of Swedish welders (occupationally exposed to aluminum dust and fumes for over ten years at a mean exposure level of 10 mg/m3 of aluminum), and a control group of individuals with normal levels of aluminum in their body. The test group reported more symptoms of central nervous system disorders, had decreased motor function and were slower with memory recall than the control group. The test group had an average of seven times as much aluminum concentration in their urine as the control group. The authors of this study said they were not surprised by their findings and claim that aluminum is firmly established as a neurotoxin in humans. This assertion is based on high incidents of encephalopathy in patients with renal function failure. Known as dialisys encephalopathy, research has shown a link between aluminum intake and neurological dementia, since dialysis patients are exposed to high levels of aluminum in dialysis fluids and medications. Previous studies of welders exposed to aluminum in Sweden and Finland (Sjogren, Gustavsson, Hogstedt,1990; Hanninen, Matikainen, Kovala, Valkonen, Riihimaki,1994) showed symptoms of central nervous system disorders. The predominant symptom of fatigue in this study differed from major symptoms in the other studies which were negative relationships between aluminum and short term memory; learning; attention; and depression. In conclusion, these studies suggest that neurotoxic effects are probably caused by the excessive occupational aluminum exposure, indicated by increased urinary levels when compared to levels of unexposed individuals (Sjogren, et al.1996).

Another study in the area of neurological disorders resulting from aluminum exposure was performed in 1993 by the National Institute for Occupational Safety and Health (NIOSH). A Health Hazard Evaluation was performed at an aluminum smelter in Ferndale, Washington, after three employees contacted NIOSH concerning the development of a disease amongst workers. The disease, characterized by tremor, balance problems, bone and joint aches and memory loss was documented in a previous study at the Washington smelter (Longstreth et al. 1985). A total of eleven workers had filed workers compensation disability claims related to neurological disorders.

It is interesting to note that this is only one of three published studies done involving neurological disorders in aluminum smelter workers (USDHHS, 1995). In their study of 444 aluminum electrolysis workers, Langauer-Lewowicka and Braszczynska (1983) found a 9% prevalence of neurological problems (USDHHS, 1995). The other study of 38 workers in a Norwegian aluminum plant (Bast-Pettersen et al, 1994) showed that potroom and foundry workers were more likely to have reported three or more neuropsychiatric symptoms than workers in the control group. Major symptoms included tremor and impaired visuospatial organization. Major symptoms of exposure in the NIOSH study were incoordination, tremor and memory loss (USDHHS, 1995).

Based on past studies, NIOSH found that there is some evidence that points to aluminum being neurotoxic. It has been documented as a neurotoxin in animal studies, is a well-accepted cause of dialysis encephalopathy, and has been shown, in a study of miners purposely exposed to finely ground aluminum, to affect cognitive function (USDHHS, 1995). The Health Hazard Evaluation was designed to test the hypotheses that workers exposed to higher levels of aluminum would show higher prevalence of neurologic symptoms. In order to accomplish this, a test group and a control group were given batteries of neurological tests and physical examinations to test for signs and symptoms like: tremor, postural stability, vocabulary and reaction time.

Based on twenty years of industrial hygiene data from the Washington plant (over 2,000 area and personal samples), NIOSH estimated the mean exposure to aluminum was 12.5 mg/m3 in the potroom, where these symptoms were reported. The control group, which came from areas other than the potroom, had estimated exposures of 10.5 mg/m3 of aluminum in the carbon plant and 4.5 mg/m3 of aluminum in the cast house. Keeping in mind that the TLV for aluminum is 10 mg/m3 (ACGIH, 1997), all workers were fairly exposed. Based on the results of their evaluation, NIOSH found no statistically significant differences between the test group and control group and concluded that there were no objective neurological indicators related to occupational exposure of aluminum in this particular study, (USDHHS, 1995).

Another contemporary issue related to the central nervous system and aluminum exposure is Alzheimer's Disease. In a study done by Doll (1993), it was concluded that workers exposed to high levels of aluminum (over 10 mg/m3) face possible neurotoxic effects, but that there is not enough evidence to suggest that their occupational exposure means they are more likely to have Alzheimer's Disease. He performed epidemiological studies on people exposed to aluminum environmentally (drinking water, medications high in aluminum content, etc.) and workers involved in the refinement and welding of aluminum. The workers clearly showed higher concentrations of aluminum in their bodies and increased symptoms of mental impairment. However, the progressive mental dementia associated with Alzheimer's was not noted.

What is fairly well known about the pathological findings of Alzheimer's is that an above average amount of aluminum has been found in the brains of victims. What is unclear about this finding, is whether the aluminum is a cause or an effect of the disease.

Scientists are investigating several theories to determine the causes of Alzheimer's disease, and at this point, aluminum cannot be blamed, nor should it be ruled out. (Beliles, 1994).

Currently, the effects of aluminum exposure and neurological functions are controversial. Proctor (1991) suggests associations of high aluminum concentrations in the brain with renal function failure, yet states in the same paragraph that in three cases involving renal failures and workers in an aluminum plant, that evidence was fairly minimal. Dichotomies like these are not uncommon in the relatively scant research related to occupational exposure to aluminum and its effects on the central nervous system.

Aluminum and the Respiratory System

Shaver's Disease, a type of respiratory illness, was discovered in the 1950's when it was found that 23 Canadian workers exposed to fumes resulting from the production of corondum (minute particles of aluminum oxide) were developing pulmonary fibrosis. The disease proved fatal in seven cases. 245 people in Shaver's study had chest x-rays and 35 showed "definite" changes. Particles the subjects were exposed to were from 0.02 microns to .5 microns in diameter. In addition to the fatalities above, there have been 3 reported in Britain (Proctor, 1991), one in Japan (Beliles, 1994) and none in the United States. All of the fatalities were in the 1950's.

For the aluminum worker it is fundamentally important to understand that the size of the particles involved were "ultramicroscopic" and that the disease was associated with the manufacturing of aluminum oxide and pyro powder, not molten metal. Beliles (1994) states that aluminum dust produced from molten metal is courser than the dust associated with carborundum and is considerably less dangerous. Furthermore, there have been repeated investigations of laboratory animals exposed to aluminum in various forms that demonstrate that aluminum inhalation does not produce fibrogenic effects like scarring of the lungs (Beliles, 1994).

Nevertheless, the potential for lung disease remains. In a study of uncommon pneumoconiosis (common ones resulting from coal dust or cotton), Akira (1995) apparently contradicts the previous paragraph when he states that:

> "inhalation of dusts containing metallic and oxidized aluminum has been reported to be associated with development of pulmonary fibrosis. Results in experimental studies in animals have shown that localized granulomatosis and fibrotic lesions may develop if sufficiently large quantities of aluminum-containing particles are introduced into the respiratory tract." (p.407)

One paragraph later, he tempers this statement by saying that pneumoconiosis directly attributable to aluminum metal and its oxides is rare, even though exposure is very common.

Between 1944 and 1979, McIntyre powder, consisting of finely ground aluminum and aluminum oxides (1.2 microns in diameter) was used as a prophylactic agent to guard against silicotic disease in miners in northern Ontario. The miners inhaled the particles for 10 to 20 minutes before each underground shift. Thus far, no negative health effects with relation to the respiratory system have been reported. This study, done by the McIntyre Research Foundation, is the basis of the ACGIH TLV of 10 mg/m3 (Beliles,1994; Proctor, 1991).

<u>Aluminum's Association with Cancer</u>

In the primary aluminum industry, the smelting takes place in an area called a potroom. It is important for the worker in the secondary industry, where there are no potrooms, to understand the relationship with potroom emissions and information related to aluminum and carcinogenicity. The secondary industry is basically remelting and refining scrap aluminum. The primary industry is making "primary" aluminum from its naturally occurring state, bauxite. The process in the potroom, which causes the emissions, is electrolysis. The aluminum oxide (or alumina) is added to pots of cryolitic solution which contain fluorine. When an electrical current is passed through the pots, the oxygen disassociates leaving pure or "primary" aluminum. The electricity passes through anodes and cathodes which are consumed in the process. The anode, which is a baked mixture of coke and petroleum pitch, is reduced to gases and particles containing carbon monoxide, carbon dioxide, sulfur dioxide and various hydrocarbons (Beliles, 1994).

The hazardous material generally associated with potroom emissions is coal tar pitch volatiles (CTPV). CTPV's produce polycyclic aromatic hydrocarbons (PAH), known to be carcinogenic. Research has shown CTPV's and PAH's to be associated with lung cancer, bladder cancer, and a disease known as potroom asthma; none of which can be presently attributed to occupational exposure to aluminum (Tremblay, Kreik, Ronnenberg, 1995).

<u>Sampling and Exposure Limits</u>

For occupational exposure to aluminum, the Occupational Safety and Health Administration (USDHHS, 1997) has set a Permissible Exposure Limit (PEL) of 15 mg/m3 and 5 mg/m3 for respirable size particles. The American Conference of Governmental Industrial Hygienists (ACGIH, 1997) has set a Threshold Limit Value

(TLV) for aluminum at 10 mg/m3 and 5 mg/m3 for respirable size. The respective limits are exposure limits set for nuisance dusts, which means they are basically inert.

Though listed as "under study" the ACGIH does not presently have a biological exposure index listed for aluminum. The research showed that urinary levels were the preferred method for testing (Gitelman, 1995; Schaller, 1984; Rollin, Theodorou, Cantrell, 1996). The Pocket Guide to Chemical Hazards (US DHHS, 1997) suggests the NIOSH method 7013 for sampling aluminum or method 7300, which scans for 30 metals.

Hydrogen Chloride

A process in the smelting of aluminum, known as de-magging, is used to eliminate or reduce the concentration of magnesium in the aluminum alloy. When chlorine gas is injected into the metal bath, it reacts with the magnesium and forms magnesium chloride. Magnesium chloride, which is lighter than aluminum, rises to the surface and is skimmed off the top of the metal bath periodically. Magnesium chloride, when heated to decomposition, may emit toxic fumes of hydrogen chloride (Ruger Chemical, 1991).

Hydrogen chloride is a colorless, corrosive, nonflammable gas that fumes in the air. It is characterized by a pungent, suffocating odor which can be detected at 0.77 parts per million (ACGIH, 1991). Being a corrosive, it can attack and destroy exposed body tissues. Corrosives can also attack and even destroy metal. Corrosives can burn and destroy body tissue on contact. Effects depend on the concentration of the corrosive and exposure time. Corrosive materials can severely irritate, or in some cases, burn the eyes, and even cause scars or permanent blindness. Corrosives touching the skin can severely irritate, burn and blister the skin. Breathing in corrosive vapors irritates and burns the inner lining of the nose, throat, and respiratory tract. (Canadian Centre for Occupational Health and Safety, 2000).

The PEL (USDHHS, 1997) for hydrogen chloride is 5 parts per million (ppm) as a ceiling limit. A ceiling limit value means it should not be exceeded. The ACGIH and NIOSH also use 5 ppm as their respective TLV and REL ceiling values. (ACGIH, 1997; US DHHS, 1997). NIOSH also has an Immediately Dangerous to Life and Health (IDLH) limit of 100 ppm. IDLH is defined in the *NIOSH Pocket Guide to Chemical Hazards* as “a condition that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment” (p. xii). Methods for sampling include NIOSH Method 7903, OSHA Method 126, or colorimetric detector tubes (US DHHS, 1997).

Acute effects of exposure to 5 ppm of hydrogen chloride include irritation to the eyes, nose and throat, but are not characterized by any long term effects. The “no-effect” level of exposure is estimated to be between 0.2 to 10 ppm. One fatality due to exposure to hydrogen chloride has been reported (Perry, Smith, Kent, 1994). Other acute effects include severe skin and eye irritation and burns that could lead to permanent blindness. Breathing higher concentrations could also cause pulmonary edema (fluid in the lungs) (NJ DHSS, 1995).

Chronic health effects include erosion of the teeth which is characterized by the loss of tooth substance. In cases produced by the presence of acid, the changes are loss of enamel and dentin from the surfaces contacted by the acid (Ash, 1986). Eroded teeth can be bracketed and marked (Woodal, Dafoe, Young, Weed-Fonner, Yankell, 1989). The shape of the marks vary from shallow saucer-like depressions to deep wedge-shaped grooves. Ulcers in the nasal and oral mucosa are also symptoms of exposure to hydrogen chloride. These ulcers, marked by a gray to yellowish center, surrounded by a red border, are the result of the corrosive action of hydrogen chloride (Wilkins, 1989). Other chronic effects include lung irritation, bronchitis and shortness of breath (NJ DHSS, 1995). Based on animal and human research, the International Agency for Research on Cancer (IARC) concluded that hydrogen chloride is not classifiable as to its carcinogenicity (Perry, Smith, Kent, 1994).

Past Sampling Data

Air monitoring at Spectro Alloys has been done in five separate years. In July, 1992, a MNOSHA inspection produced a report showing data for chlorine levels and a metal scan done at furnace one, furnace three, and a scrap shredder. Personal sampling was performed by Fee Foo Lee, an OSHA investigator. A calibrated SKC Aircheck 50 sample pump was used to sample particulates. Colormetric tubes were used to identify chlorine levels. There is no data available listing flow rates or sample time. Results showed aluminum levels at .106 mg/m3. Chlorine was not detected. Trace amounts of arsenic, chromium, copper, lead and zinc were found.

On October 12, 1997, air sampling was performed by Jim Schultz, of Spectro Alloys, at a furnace area associated with numerous employee complaints. Total particulate levels were sampled using a calibrated SKC Aircheck sample pump. The pump was located in a “pit” in the employee’s breathing zone for approximately eight hours. Flow rate was 2.3 liters per minute. 37 mm PVC filters were used. Results showed total particulate levels to be .19 mg/m3.

On July 8, 1998, air sampling was performed by Jim Schultz at furnace three for the purpose of assessing particulate levels in building four. Sampling was done using a calibrated SKC Aircheck sample pump. Filters were located in the breathing zone for approximately eight hours. Flow rate was 2.3 liters per minute. 37 mm PVC filters were used. Total particulate levels were 1.1 mg/m3.

On April 30, 1999, Noble Rainville, a loss control consultant form Kraus Anderson Insurance, performed air sampling for particulate levels, to include aluminum. A furnace worker in the “pit” wore a calibrated SKC Aircheck sample pump for approximately five hours. Another furnace worker, involved with operating the furnace wore a similar pump for the same amount of time. Flow rate was 1.8 liters per minute. 37 mm PVC filters were used. The pit sample showed .96 mg/m3 of total particulate and .25 mg/m3 of aluminum. The other sample showed a total particulate level of .58 mg/m3.

Chlorine is continuously monitored at Spectro Alloys. There is a monitor in the chlorine control room that will sound an audible alarm if there is a leak. There are also sensors at each furnace where the chlorine is injected. These sensors will automatically shut off an electronic valve and collapse the regulator in the control room should chlorine exceed .5 ppm.

Risk Communication

Over the years, people have been made aware of potential health effects of exposure to chemicals. The media has played a big part. It is not uncommon to watch the nightly news and see a special report on the effect of chemical "X." The government has also heightened peoples' attention by enacting numerous laws requiring companies to share information regarding risk with employees, and in some cases the public. A recent example is the Environmental Protection Agency’s Risk Management Plan, which made it law for companies with highly hazardous chemicals to make hazard information available on the internet. As a result of increased public interest and a diminishing faith in industry and government, a type of communication known as "risk communication" has evolved. A communications expert, Vincent T. Covello, says that "risk communication occurs when there is an exchange of information among interested parties about the nature, magnitude, significance or control of a risk" (Sheldon, 1996). Concentrating on the disparity between real risk and perceived risk, the components of risk communication are similar to general communication: the source, the message, the message channel and the recipient of the message (Oleckno, 1995).

The effectiveness of the message will increase as trust in the messenger increases. Depending on the recipient, trust may be affected by the source's knowledge (or lack of), but is usually related to the source's objectivity, social class and previous messages sent by the organization with which the source is related. Sometimes the source's aura or expertise may actually prove harmful to the message. Leiss (1996) explains, "there exists on the part of the public a profound distrust for experts and the institutions they represent, which weakens the force of the quite sensible contributions that technical experts can make to the public discourse on risk taking." (p.4)

The message channel depends on the group receiving the message (recipient). According to Viscusi who writes about hazard communication, we should remember, in our messages, to refrain from "information overload." He suggests limiting the message to five or seven pieces of information (Viscusi, 2000). The message also needs to balance what is known as "hazard and outrage" (Oleckno, 1995). This is basically balancing the known scientific data with opinion. A well known example of this would be the relationship of aluminum and Alzheimer's disease. If the source is involved in a high concern/low trust situation, one of the most important aspects of communication is non-verbal. Non-verbal actions, like poor eye contact, can totally defeat the message. (Sheldon, 1996). Covello concludes that the risk message should be scientific, data-based, and ethical.

Perception of the recipient, which is the most important factor regarding effective risk communication, depends both on the background of the recipient, as well as the way they interpret the source or the message. Covello (Sheldon, 1996) identifies specific factors which positively influence the perception of the recipient: perceived caring and empathy; perceived competence and expertise; perceived honesty and openness; and perceived dedication and commitment. If these qualities can be perceived by the recipients, the source will be viewed with trust and credibility, and the message will be effectively communicated.

Sharing Information

With regards to planning and implementing training, OSHA's *Voluntary Training Guidelines* provide the safety and health practitioner critical training factors (Cohen, Colligan, 1998). Similar to OSHA's version, The National Cancer Institute also designed a guide to provide a framework for health communication. *Making Health Communication Work: Planner's Guide* (National Institute of Health, 1989) is a tool to evaluate scenarios involving the sharing of hazards and health-related information. Divided into the following six stages, the guide takes a step by step approach in health communication program development and evaluation (Sattler, Lippy, Jordan, 1997).

Planning and Strategy Selection This is basically identifying the problem and establishing objectives to measure success. A comprehensive outline of the problem should be made. In addition, there should be a plan created to change or lessen the problem. The target audience, as well as the information that will be shared with this audience, should be identified.

Selecting a Medium and Materials The coordinator needs to be creative and find what's available. It is wise to adapt existing materials to the program. When developing materials, it is imperative that materials are appropriate for the target audience. Availability also comes into play. For example, a slide presentation may not be the best medium if the organization doesn't own a slide projector. The materials used must be objective and appropriate for the target audience.

Developing Materials and Pretesting It is noted that 22% of American workers are functionally illiterate and that too much technical information should be avoided (Sattler, Lippy, Jordan, 1997). Materials should be evaluated and audience reaction assessed. There is a set of four questions that the guide recommends with regards to the audience: 1) Does the audience understand the message? 2) Does the audience recall it? 3) Does the audience accept it as important? 4) Does the audience agree with the value of the solution? It is important to listen to the audience, as risk communication is a partnership.

Implementing the Program Implementation is when all of the "stakeholders" are aligned in order to meet the goals of the program. Program components should be continuously reviewed in order to assess whether the target message is getting through. Cohen and Colligan (1995) reviewed several outstanding hazard control programs and found invariably, that the first line supervisor was a key component of success. A question offered by the guide, “Is the target audience paying attention and reacting?” is a good way to measure quality of training given.

Assessing Effectiveness The end results of the program are compared to the goals or objectives set in the beginning. In an evaluation of hazard communication at Ford, it was determined that “more interactive, trainer intensive delivery methods to smaller groups were associated with more positive effects on reported training usefulness and changes in work practices and working conditions” (Robins et al. 1990).

Feedback to Refine the Program With feedback, the more information that can be gathered, the more likely it is that the following questions will be answered: “Why has the program worked or not worked?” “Are there lessons learned that could make future programs more successful?” (Sattler, Lippy, Jordan, 1997)

Trust in Organizations

It would seem that the value of trust in organizations is easy to see. Work-related or otherwise, most everyone would agree that trust is essential as a foundation in any relationship. Webster says trust is "a firm belief or confidence in the honesty, integrity, reliability, justice, etc. of another person or thing.” Francis Fukuyama, a frequent commentator on trust, defines it as "the expectation that arises within a community of regular, honest, and cooperative behavior, based on commonly shared norms, on the part of other members of that community” (Sojka, 1999)

In relation to business, Fukuyama's definition is intriguing, as it is often quite challenging for organizations to arrive at behavior that has management and employees cooperatively seeking the same goals (e.g. mission statements), since their interpretation can be quite subjective. Building this trust should be one of the highest priorities of leaders in organizations. “Relationships leaders build with their followers are a powerful variable affecting their success and more importantly the effectiveness of their followers” (Cole, 1999). It is quite possible that no other component affects the working relationships as much as trust. Without fulfilling a basic need like trust, it's highly unlikely that any higher, more complex aspiration (e.g. team building) would be reasonable. "Lack of trust tears at the very fibers of creativity, feeling valued as an employee and the commitment to produce at the 110% level” (Cole, 1999). Sojka (1999) concludes that the issue of trust is so crucial that there may actually be no substitute for trust. He states that when it becomes clear that one falls under the category of low trust there is “nothing one can do apart from summarizing his or her findings.” Fukuyama (1995) says trust is a “social virtue indispensable in creating prosperity.” If getting everyone on the proverbial “same sheet of music” in organizations is truly a goal, statements like these should catch management's attention.

Sojka (1999) makes the following statements, which are quite appropriate for this study because of their analogous nature to the culture to be examined:

> “Mistrust, consists in a lack of commitment and in calculativeness which are characteristic of a self-interested, isolated individual equipped with egoistic or "tribal" motivations. Lack of commitment can have two sources. One is the familistic, tribal trust and "commitment" to the narrow circle of "our" people in which calculativeness is a facade of familistic trust. The second source is the atomization of anomic society composed of self-centered, self-interested individuals, devoid even of familistic ties or commitments.” (p. 10).

It is not unrealistic to compare an organization with a low-trust culture with an anomic society (characterized by a breakdown or absence of social norms and values).

With a strong "Us vs. Them" attitude, organizations lacking trust can degrade to dysfunctional proportions. Organizations with long-term employees may have developed the familistic type of trust, where they seemingly look out for each other and stand up to “the man.” The anomic comparison may unfortunately becoming more of a reality today, as organizations with low-trust cultures are quite likely to be experiencing high turnover.

Conversely, a company that invests in building a high-trust culture will build commitment. Levinson (1999) defines commitment as “mutual loyalty and trust between people, and their leader, and their organization.” When there is commitment on both sides of organizations, the likelihood of goals being meaningful to employees and management is much greater. The idea of things like mission statements being meaningful to employees is more realistic when there is a high-trust culture, characterized by commitment. High quality and low cost, which are at the heart of Spectro’s mission statement are noted by Covey (1999) as benefits of a high-trust culture. He further states that the global economy has raised the bar so high that it requires organizations to have high-trust cultures to survive.

When getting to the so called “bottom line” of a high-trust culture, companies want to be able to say that they actually do what they say they do ("walk the talk"). If a company’s mission statement says that it leads with integrity, then its actions must prove it. Covey (1999) says that if a company has a high trust culture, people will come to realize that the mission is not just about words or slogans. A high trust culture will bring about the marriage of what he calls “idealism and pragmatism.”

<u>Information Obtained via Personal Communications</u>

Keith Giorgi, an industrial hygienist from Legend Technical Services, in St. Paul, was contacted numerous times (personal communication, October, November, 2000), for the purpose of air sampling advice. Mr. Giorgi suggested that initially, an area sample for particulates would be appropriate since this was a baseline exercise. There had not been a cyclone dust separator or a vortex feeder at Spectro before. Both of these new sources were visibly creating excessive dust and both creating a lot of attention. An area sample at the source would provide a worst case scenario, since a worker does not stand at the source for eight hours a day. A sample at the source would also provide sufficient media with which to perform a metal scan. Mr. Giorgi also provided the necessary information to purchase a sampling pump and colormetric tubes for the hydrogen chloride sampling.

Joshua Harney, an industrial hygienist from NIOSH, was contacted November 2, 2000. The sampling strategy suggested in the preceding paragraph was shared with Mr. Harney. Mr. Harney concurred that an area sample was a good place to start, and that personal sampling could follow if there were high levels or possibly, employee concerns. Mr. Harney works in the Division of Surveillance, Hazard Evaluations and Field Studies. He suggested that Spectro apply to NIOSH for a Health Hazard Evaluation. He sent brochures explaining Health Hazard Evaluations and also sent an application form. In addition, a Health Hazard Evaluation Report (HETA #95-0244-2550) from a secondary aluminum smelter in Arkansas showed that worker exposures included dangerous levels of chlorinated substances like hydrochloric acid vapor and metal dusts like aluminum and lead.

Mr. Harney agreed that aluminum dust and hydrogen chloride were main concerns in the realm of air contaminants, but strongly encouraged Spectro's management to study the option of having NIOSH perform a Health Hazard Evaluation. By having an outside source, such as NIOSH, provide an evaluation of this nature, Spectro could provide an objective and credible source with which to relay the message of risk associated with the results of the Health Hazard Evaluation. Mr. Harney summarized by stating that there may be many benefits of having an outside source come to a culture where low trust exists.

Brian Alexander, an industrial hygienist from Minnesota OSHA, was contacted several times (October, November, 2000) during the course of this study. The purpose of contacting Mr. Alexander was to ensure that the sampling strategy of doing a baseline area sample was legitimate. This strategy was acceptable to Mr. Alexander. He also stated that if unacceptable levels were identified, that personal sampling would be required and that our Right to Know program should include all potential hazards, even when they are below acceptable levels of exposure. Being somewhat familiar with Spectro, Mr. Alexander thought the major contaminants would be aluminum dust and chlorine.

The five largest secondary aluminum facilities in America were contacted by fax and phone. The purpose of the contact was to find out what they are sampling for and how they are going about the business of gathering and sharing information. None of the five contacts were willing to share information of this type with Spectro Alloys.

Other contacts included Integrated Loss Control, Inc., a company from New Brighton which provides industrial hygiene services. Gary Caple, a vice president from Integrated Loss Control, who has previously performed air sampling at Spectro, submitted a summary cost estimate with which his company would do a survey at Spectro

Alloys to identify levels of air contaminants at the furnace, baghouse and shredder areas. The tests suggested included a metal scan, sampling for aluminum dust, and sampling for metals to include chrome, copper, lead and zinc. The Aluminum Association and The Chlorine Institute, trade organizations with which Spectro is not a member, limited their contribution to catalogs of publications.

Summary

The review of literature revealed several health-related issues related to exposure to aluminum and hydrogen chloride. Aluminum has been associated with Alzheimer's disease, respiratory illnesses and cancer. Hydrogen chloride, which is a corrosive, also possesses harmful health effects, which include tooth erosion and permanent blindness.

The impact trust has in organizations is immense. Without a trusting relationship between employees and management, information sharing is difficult. Past air sampling data at Spectro Alloys shows that contaminant levels are low when compared to permissible exposure limits. The planning guide for sharing health information created by the National Institute for Health provides the risk control manager a blueprint to use when attempting to gain trust by implementing a program for gathering and sharing information related to employee exposure to air contaminants and related health effects.

Chapter 3

Methodology

Method of Study

The main objectives of this descriptive study were to identify hazardous air contaminants at Spectro Alloys and to identify methods of gathering and sharing information related to employee exposure. Methods used to accomplish these objectives included reviewing related literature; assessing employee exposure by performing air sampling and reviewing existing air sampling data; and by conducting personal communications with professionals in the field of occupational safety and health.

Outline of Literature Reviewed

I. The contaminants. The contaminants identified were aluminum and hydrogen chloride. The first section of the review of related literature examined the health effects and exposure limits of aluminum and hydrogen chloride.

   A. Exposure to aluminum. An introduction to aluminum identified the concerns that have evolved due to occupational and environmental exposure. The main concerns are effects on the central nervous system, the respiratory system, and aluminum's association with cancer.

1. <u>Effects of exposure related to neurological disorders.</u> Studies have been done with respect to aluminum exposure and its relationship to Alzheimer's disease and other neurocognitive functions. A European study confirms the association, and an American study performed by the National Institute for Occupational Health (NIOSH) disputes it.

2. <u>Effects of exposure on the respiratory system.</u> Two major studies have been done to identify the effects of aluminum on the respiratory system. One of the studies where aluminum powder was purposely inhaled for 30 years is used to set the American Conference of Governmental Industrial Hygienists' Threshold Limit Value (TLV) for aluminum.

3. <u>Aluminum's association with cancer.</u> This section provides the worker in the secondary industry (peculiar to this study) an explanation for incidents of cancer which have arisen in the primary aluminum industry.

B. <u>Hydrogen chloride.</u> The formation of hydrogen chloride in the smelting setting was discussed. Its corrosive characteristics, as well as its acute and chronic effects were reviewed.

1. <u>Corrosivity.</u> As a corrosive, hydrogen chloride can be damaging to the environment and the exposed employee.

2. <u>Acute effects.</u> Permissible exposure limit and known health effects were discussed.

3. <u>Chronic effects.</u> Long term health effects of exposure to hydrogen chloride, such as tooth erosion, were examined.

II. <u>Methods of Sharing Information.</u> An overview of the science of risk communication was given. In addition, a method for sharing health communication was discussed. Finally, the benefit of trust in organizations was reviewed.

A. <u>Risk communication.</u> Bridging the gap between opinion and science, risk communication is based on the principles of general communication.

1. <u>The source.</u> The messenger's impact will depend on several factors to include objectivity, credibility and past messages sent by the organization.

2. <u>The message.</u> Much thought is necessary when choosing the message. Its successful delivery weighs heavily on trust established between the source and the recipient.

3. <u>The message channel.</u> The channel depends both on the target audience and the resources available within an organization.

4. <u>The recipient.</u> The most important factor in the risk communication process may well be the recipient and their view of the source and its message.

B. <u>Planning for sharing of information.</u> A strategy devised by the National Cancer Institute was chosen and used as a guide to develop information sharing programs. The process has six stages:

1. <u>Planning and strategy selection.</u>

2. <u>Selecting a medium and materials.</u>

3. <u>Developing materials and pretesting.</u>

4. <u>Implementing the program.</u>

5. <u>Assessing effectiveness.</u>

6. <u>Feedback to refine the program.</u>

C. <u>Trust in organizations.</u> The literature reviewed examined companies where no trust existed versus companies classified as having high trust cultures. When trust exists between management and employees, commitment is a byproduct of both entities. When there is a lack of trust, there is ultimately a lack of commitment, which can result in poor performance and attrition of the workforce.

<u>Personal Communications</u>

Keith Giorgi, an industrial hygienist from Legend Technical Services in St. Paul, MN, was consulted several times. Mr. Giorgi did the lab work for the samples taken during the study, answered many questions, and provided practical guidance in the area of identifying air contaminants.

Josh Harney, a NIOSH investigator who works in the Health Hazard Evaluation (HHE) program, was contacted for the purpose of getting a professional opinion on identifying and communicating hazards. The HHE is conducted when a group from NIOSH comes to a facility to perform monitoring, medical surveillance, and make an assessment of the hazards employees are facing.

Brian Alexander, a compliance officer at Minnesota Occupational Safety and Health (MN OSHA) and an industrial hygienist, performed a health inspection at Spectro

Alloys in 1997, and has been contacted several times during the course of this study for the purpose of confirming acceptable sampling methods.

The five largest secondary aluminum smelters in America were contacted for the purpose of finding out their strategies for gathering and sharing information related to air contaminants in their facilities.

Past Sampling Data

Data from previous sampling performed at Spectro Alloys is limited to an OSHA inspection in July, 1992 which detected no chlorine and trace levels of heavy metals (aluminum levels were .106 mg/m3); sampling performed by Jim Schultz in October, 1997 showed total particulate levels to be .19 mg/m3; sampling performed by Jim Schultz on July 8, 1998 showed total particulate levels of 1.1 mg/m3; and finally, sampling performed by a loss control consultant in April of 1999 showed levels of aluminum at .25 mg/m3 and total particulate levels of .96 mg/m3.

Current Sampling Data

Spectro currently has two new pieces of equipment which have produced an excess of airborne particulates. The vortex feeder is a shaker, which agitates the scrap and causes particulate matter to float down into the pit where the furnace worker skims the ingots. The other piece of equipment is known as a cyclone dust separator. When the cyclone empties into a steel box it creates a cloud of dirt and metal. The cyclone is part of the drying process. At the end of the drying process, the scrap goes through a penthouse. The penthouse is periodically cleaned by the dryer operator and has traditionally been a location where people have complained about working.

Sampling at the vortex feeder was done October 26, October 27, and October 31, 2000, with a calibrated SKC Aircheck sample pump. The sample pump was set up in the breathing zone in the pit. Three samples were taken on three different days. One of the three samples was taken in front of a man cooling fan which is on nine months out of the year. The other two were not in front of the fan. Sample time was approximately six hours for each sample. It was requested that one of the samples be analyzed for metals. Flow rate was 2.3 liters per minute. 37 mm PVC filters were used.

Sampling at the cyclone and penthouse was done November 1 and November 2, 2000 with a calibrated SKC Aircheck sample pump. The sample pump was located right at the cyclone, which would give the worst case scenario. An additional sample was taken at the penthouse, which is an enclosed building of approximately 1000 square feet. Sampling time was approximately six hours for each sample. A metal scan was done in addition to total particulate levels for both sampling areas. Flow rate was 2.3 liters per minute. 37 mm PVC filters were used.

Hydrogen chloride was also sampled. On November 15, 2000, No. 14L Sensidyne detector tubes were used with a Sensidyne No. 800 Gas Sampling Pump Kit. To verify that hydrogen chloride was actually present, a sample was taken directly from a bucket of dross. The sample taken required 1000 ml of air to be drawn through the pump, and a wait of one minute to read the sample. Additional samples were taken at the tap end and in the furnace workers' breathing zone. Sampling for hydrogen chloride was done at furnace one and furnace three.

Gathering and Sharing Information

A strategy for effectively sharing information was created based on the model of risk communication, the planning guide for health communication, and the culture and available resources at Spectro Alloys Corporation. With trust-building as an ultimate goal, research-based health hazard data, supported with data from past and current air samples was shared with Spectro employees.

Chapter 4

The Study

Introduction

The purpose of this study was to assess and describe ways in which organizational trust-building can be enhanced by identifying effective methods of gathering and sharing information related to occupational exposure to air contaminants at Spectro Alloys Corporation. The goals of the study were to identify hazardous air contaminants at Spectro Alloys Corporation; measure air contaminant levels to assess risk; and identify methods to effectively share information related to air contaminants and associated risks.

A combination of methods of research was used to complete this descriptive study. A review of related literature, which was the primary method, provided information pertaining to employee exposure to aluminum and hydrogen chloride, methods for communicating risk, and a perspective on trust in organizations. Past and current air sampling data was used as the information to be shared with affected Spectro employees. Personal communications with employees at Spectro Alloys provided valuable feedback related to gathering and sharing air quality information. Finally, personal communications with individuals possessing knowledge and experience in the field of industrial hygiene and risk communication were consulted for advice during the course of the study.

Information from Literature Reviewed

The main information shared from the literature reviewed included the health hazards associated with aluminum and hydrogen chloride. In addition, signs and symptoms of exposure, permissible exposure limits, and controls, to include personal protective equipment, were also shared with affected employees. A planning guide designed by the National Institute of Health, which provides steps for making health communication work, was used as a checklist when the information sharing sessions were created.

With the ultimate goal of building trust, the planning for sharing information was based on the relationship between Spectro employees and their management. The data showed low levels of air contaminants, but the history of mistrust between employees and management presented the problem of the message source and the message recipient having opposing views of the message.

The literature showed that trust is one of the most invaluable characteristics of successful organizations and that building this trust takes caring and empathy; competence and expertise; honesty and openness; and dedication and commitment on the part of the source, which in this case would be Spectro Alloy Corporation's management, and more specifically, people responsible for risk control.

Based on feedback and past surveys from Spectro employees, the biggest concern was the inhalation of aluminum dust. The hydrogen chloride, which is very noticeable due to its strong odor and the excessive rust throughout the facility, is also frequently mentioned as a problem. It is mistakenly identified by employees as chlorine or magnesium chloride, but is truly a concern as it is very irritating to the affected employee.

The recent influx of complaints associated with the vortex feeder at furnace three and the cyclone dust collector at the dryer, made both an obvious choice of sampling for the purpose of this study. The penthouse above the dryer has historically been an area where high levels of dust and employee complaints have existed, so it was also a natural choice for this problem.

Past Sampling Data

Table 1 - Past Sampling Data: Aluminum in mg/m3 at Furnace 3

Year	1992	1997	1999
Concentration	0.11	0.19	0.25

* The OSHA Permissible Exposure Limit (PEL) for aluminum is 15.0 mg/m3

Air sampling done at furnace three, where the majority of concern has been, is limited to data from four different years. The data shows very low levels of aluminum dust when compared to OSHA's permissible exposure limit of 15 mg/m3. The information shown in Table 1 shows the highest level of aluminum dust sampled to be .25 mg/m3, which is 60 times lower than OSHA's permissible exposure limit. Samples taken for total particulates at Furnace 3 show similarly low levels when compared to the permissible exposure limit of 15 mg/m3.

Table 2 - Past Sampling Data: Total Particulates in mg/m3 at Furnace 3

Year	1997	1998	1999
Concentration	1.3	1.1	0.96
* The OSHA PEL for Total Particulates is 15.0 mg/m3			

On the previous page, Table 2 shows that 1.3 mg/m3 was the highest concentration of particulate matter found at furnace three. There are no records of sampling done for particulates at furnace three prior to 1997. The 1992 OSHA inspection did not include particulate sampling.

Table 3 - Past Sampling Data: Total Metals in mg/m3 at Furnace 3 -- July, 1992

Element	Chromium	Copper	Lead	Zinc
Concentration	0.0006	0.005	0.001	0.020
OSHA PEL	1.0	1.0	0.05	5.0

Trace amounts of chromium, copper, lead and zinc were found in 1992 when MN OSHA performed air sampling at Furnace 3 during an inspection. Results are shown in Table 3.

The rust on the steel in the facility was believed to be due to chlorine exposure. Chlorine is constantly monitored at Spectro Alloys with gas monitors at the furnaces and in the control room. These monitors sound audible alarms if there is chlorine in the atmosphere. The smell of hydrogen chloride is quite similar to chlorine, yet has never set off a chlorine alarm. Prior to this study, Spectro Alloys has not tested the air for hydrogen chloride.

Current Sampling Data

Table 4 - Current Sampling Data: Total Particulates in mg/m3 -- Oct/Nov, 2000

Area Sampled	Vortex Sample 1	Vortex Sample 2	Vortex Sample 3	Cyclone Dirt Chute	Penthouse Above Dryer
Total	1.2	4.0	4.2	1.9	4.4

*The OSHA Permissible Exposure Limit (PEL) for Total Particulates is 15.0 mg/m3

The particulate matter samples showed some higher concentrations than what has been seen in the past. Table 4 shows levels at the vortex and the penthouse above 4.0 mg/m3. As previously stated, the OSHA PEL for particulates is 15.0 mg/m3.

Table 5 - Current Sampling Data: Total Metals in mg/m3 Oct/Nov, 2000

	Aluminum	Chromium	Copper	Lead	Zinc

Vortex	0.49	NA	NA	0.027	0.034
Cyclone	0.13	0.00067	0.0045	0.0067	0.020
Penthouse	0.24	0.0010	0.010	0.0099	0.029
OSHA PEL	15.0	1.0	1.0	0.05	5.0

On page 39, Table 5 shows the various metals found in the scrap and dirt at Spectro Alloys. The .027 mg/m3 level for lead at the vortex is more than 50 % of the PEL for lead. The concentrations found for aluminum, copper, lead and zinc are extremely low when compared to their respective PEL.

Table 6 - **Hydrogen Chloride in ppm @ Furnaces 1 and 3 -- Nov.15, 2000

Sample Number	1	2	3	4	5
Furnace One	2	1	0	2	1
Furnace One Tap End	1	0	0	1	0
Furnace Three	1	0	1	0	1
Furnace Three Tap End	0	0	0	0	0

*The OSHA PEL for Hydrogen Chloride is 5 ppm as a Ceiling Limit Value

**Note: Readings taken while dross from furnace hearth was being skimmed.

The sample pump was located in the breathing zone of the person pulling the insides at the

furnace and the person stacking at the tap ends.

Table 6 shows results of sampling done at the furnace and the furnace tap end for hydrogen chloride. Suspected to be the chemical associated with the pungent smell coming off the furnace dross, a sample was drawn at the dross bucket itself to verify that hydrogen chloride was, in fact, the chemical. The colormetric tube immediately changed colors, showing that hydrogen chloride was present. Samples were taken throughout the day. When the door of the furnace was open, and the dross was skimmed off the furnace well, samples were taken in the furnace worker's breathing zone and also at the tap-end where the other workers are present in the furnace buildings. Hydrogen chloride has a ceiling limit value of 5 parts per million, meaning 5 ppm should never be exceeded. The results showed that the levels were within acceptable parameters, as the OSHA PEL for hydrogen chloride is 5 ppm.

Data Interpretation

Goal one. The first goal of this study was to identify and measure hazardous air contaminants at Spectro Alloys. Based on information from a MN OSHA inspection in 1992, personal communications with several risk control professionals, information gained from employee feedback and literature reviewed, the major hazardous air contaminants at Spectro Alloys are aluminum and hydrogen chloride. Both contaminants are very recognizable. Hydrogen chloride possesses a very distinct, irritating smell. Its corrosive properties leave the exposed steel at Spectro visibly rusty. Aluminum dust glistens in the air. When the sun shines through openings in the roof and walls, it reflects off the shiny particles, embellishing an image of heavily contaminated air in the workers' mind. There are other trace elements in the air, to include chromium, copper, lead and zinc. Air sampling results from 1992, 1997 - 1999, and new analysis from October and November, 2000 show hazardous air contaminants at Spectro Alloys to be within acceptable levels when compared to OSHA Permissible Exposure Limits.

Goal two. The second goal of this study was to identify methods to effectively share information related to air contaminants and associated risks. As a guide, the six steps outlined in *Making Health Communication Work: A Planner's Guide* (NIH, 1989), were used.

Planning and strategy selection for the training sessions involving aluminum and hydrogen chloride was based on the study's assertion that these two chemicals are the major air contaminants at Spectro. Information is plentiful. The Internet provides unlimited amounts of information. Being close to Minneapolis, the library system at the University is world class. The contaminants do have hazardous properties, but the levels at Spectro thus far, have been relatively low. The problem is that the information has not been shared. Future information sharing sessions will include training on lead, chromium, zinc, particle size, the respiratory system, and chlorine.

Channel and material selection for information sharing -- the main channel of communicating safety information at Spectro Alloys is weekly safety meetings. Safety meetings are fifteen minutes long and are conducted before the worker's shift. Spectro workers start work at either 5:00 AM or 5:00 PM. Safety meetings, which are led by the first line leader, are written by the director of safety and training. The information sharing meetings addressing the health hazards associated with exposure to hydrogen chloride and aluminum were led by the director of safety and training.

In addition to the safety meeting, other materials used for this study included a free brochure on Alzheimer's, produced by the Aluminum Association, which was ordered for each employee. A book called *Health in the Aluminum Industry* and a pamphlet called *Aluminum and Health: A review of the issues and the efforts* was purchased from the Aluminum Association and introduced and made available to employees at the information sharing meeting. All MSDS related to aluminum or by-products of aluminum were bound together and made available in the break room. A copy of the *NOSH Pocket Guide to Chemical Hazards* was purchased, introduced and placed in the break room. Several information sheets from the Internet were printed and laid out in the break room for employees to read. A bulletin board with a listing of several web sites is also in the break room.

Developing materials and pretesting is done by the director of safety and training. Each month, there are safety committee meetings and foremen meetings. The materials used at the information sharing meeting were tested at the safety committee and foremen meetings. When developing materials, information was limited to a background of the material, health hazards, permissible exposure limits, signs and symptoms of exposure, and controls. According to the literature reviewed, information overload should be avoided so the information shared should be limited to five to seven pieces of information. The employees' reading level, which may well be as low as sixth grade, needs to be kept in mind, when developing materials. Aluminum and hydrogen chloride fact sheets were developed. The fact sheets presented health hazards, exposure limits, signs and symptoms of exposure, and controls, in a simple, easy to read format. Fact sheets were posted on the bulletin board in Spectro's break room.

Implementation of the program will have to fit within the company's continuous process culture. Spectro rarely shuts down. The information sharing sessions will almost always be given at safety meetings fifteen minutes prior to the workers' shift. The sharing of information with the safety committee and the supervisors at foremen meetings will encourage both management and hourly workers to be part of the program.

A big key to building trust is creating partnerships and empowering people. During the hydrogen chloride testing phase of this study, furnace employees were asked to perform the sampling. In the future, personal sampling will involve the worker and possibly help them gain trust in the information given them. Finally, an important aspect of implementation is simply personal contact with employees. Seeking them out and sharing information on a one on one basis is quite likely to be the greatest method of gaining trust available.

Assessing effectiveness will take time. The program has just started. An attribute like trust takes a long time to build. Over time, tools to assess effectiveness will include surveys, interviews and even employee retention rates.

Presently, a method to identify effectiveness is observation. Employees are often in a position of decreasing air contaminants. Dross, for example, which contains hydrogen chloride, is heavily chlorinated. The furnace operator is in control of the amount of chlorine that is used at the furnace. The operator is also in control of the charge. The charge is the scrap being melted into the furnace. If the furnace operator is charging the furnace and the smoke is not being captured by the baghouse, they do have the option to back off on their charge. When the employee believes he/she has this empowerment, they will take the initiative to control their own outcomes, in this case, the amount of contaminants in the air.

Feedback to refine the program is presently limited to informal feedback which is basically sought by the director of safety and training through personal contact with Spectro employees and management level personnel. Hydrogen chloride and aluminum are basically pilot programs, since this type of information sharing is not characteristic of Spectro Alloys. This is a pioneer program. Some of the feedback already coming from employees includes asking for blood tests, wondering why they were never told about this before, and even some compliments, asking for more of this type of information sharing.

The information related to air contaminants at Spectro Alloys showed acceptable levels of aluminum, hydrogen chloride and other trace elements, when compared to OSHA’s Permissible Exposure Limits. The program for sharing information was tailored to Spectro’s present schedule and based on the steps outlined in the planning guide.

Chapter 5

Conclusions and Recommendations

Summary

The purpose of this study was to assess and describe ways in which organizational trust-building can be enhanced by identifying effective methods of gathering and sharing information related to occupational exposure to air contaminants at Spectro Alloys Corporation.

Goals of the Study

1. Identify hazardous air contaminants at Spectro Alloys Corporation
    1.1 Measure air contaminant levels to assess risk
2. Identify methods to effectively share information related to air contaminants and associated risks

Conclusions

The first goal was met, based on data from a past OSHA inspection in 1992, and personal communications with: Keith Giorgi, an industrial hygienist from Legend

Technical Services in St. Paul; Josh Harney, an industrial hygienist from NIOSH; and Brian Alexander, an industrial hygienist from OSHA. The major air contaminants at Spectro Alloys were identified as aluminum and hydrogen chloride. Chromium, copper, lead and zinc were also identified as trace elements which may appear during sampling at Spectro Alloys.

The sampling data, necessary to accomplish goal 1.1, indicated that both current and previous air sampling results did not exceed the OSHA Permissible Exposure Limits (PEL) for total particulates, aluminum, or hydrogen chloride.

Other heavy metals -- chromium, copper, lead, and zinc, were measured at levels well below the PEL. The highest level of aluminum measured was .49 mg/m3 in November, 2000. The PEL for aluminum is 15 mg/m3. The highest concentration of hydrogen chloride was 2 parts per million (ppm), measured at furnace one on November 15, 2000. The PEL for hydrogen chloride is 5 ppm. The highest concentration of the trace metals in mg/m3 were as follows (PEL will follow the element in parentheses): chromium (1.0) 0.0010; copper (1.0) 0.010; lead (0.05) 0.027; zinc (5.0) 0.029. These readings are from sampling conducted October and November, 2000 at the furnace three vortex feeder and the penthouse. The 0.027 mg/m3 of lead at the vortex feeder was over fifty percent of the PEL. Of all readings, this particular reading was the closest to a PEL.

The second goal, identifying methods of sharing information related to air contaminants and associated risks, was accomplished by following the six steps outlined in *Making Health Communication Work: A Planner’s Guide* (NIH, 1989).

1. Planning and Strategy Selection
2. Channel and Material Selection

3. Developing Materials and Pre-testing
4. Implementation of the Program
5. Assessing Effectiveness
6. Feedback to Refine Program

Information sharing sessions were “pre-tested” at safety committee meetings and foremen meetings. These sessions were led by the director of safety and training at employee safety meetings. The sessions covered health hazards, signs and symptoms of exposure, PEL’s and contaminant levels found at Spectro, and controls which can reduce employee exposure.

When creating the sessions, “information overload” was controlled by using slides that contained only one piece of information and by keeping the information shared to four or five main points. In addition to the presentation, resources were introduced and made available in the employee break room. Resources included fact sheets produced by the director of safety and training, fact sheets from the Internet, web site addresses, a guide to chemical hazards and two books about health in the aluminum industry.

Air sampling data was personally shared with employees who either desired to see it or whose work requires them to be in visibly contaminated areas. Feedback was sought through personal communication with management and employees. The success of this program depends on a deliberate effort on the part of management to continue to gather and share information and also the inclusion of supervisors and employees in implementing the program.

Listening to the employees’ concerns needs to translate into gathering data and communicating it to them in a way that will foster trust. Based on limited feedback from this study, the type of information sharing done thus far, is valuable at Spectro Alloys, and will help build the trust necessary in an effective employee -- management relationship.

Recommendations

1. The concept of creating a partnership with employees, supervisors and upper management should be given the highest priority. A focus group or steering committee should be created. This group should represent hourly employees, supervisors, and upper management. The risk control manager should be the leader during the formative stages. The ultimate goal of trust should be reexamined. Additionally, sampling strategies, exposure controls, and information sharing methods should be implemented.

2. A quarterly sampling system needs to be implemented at Spectro Alloys. Presently, the limited number of samples do not represent a solid data base. The plan needs to take into account the six major types of scrap: turnings, sheet, extrusions, cast, painted siding, and mixed low copper clip. In addition, the system needs to address the various processes: furnace one, furnace three, shredder, dryer, and baghouse. This study used area samples for the purpose of identifying problem areas. In the future, personal sampling should be used so employees are part of the problem solving and so readings are more realistic.

3. The pilot program of aluminum and hydrogen chloride should be expanded into an educational program with a planned curriculum, to include a glossary of terms, sections on other elements like lead, chromium, copper and zinc, and other hygiene items like particle size and how the respiratory system works. The program should make resources available to the employee by creating a library in the break room. The bulletin

board should be used to reinforce the current topic. The goal should be to empower the employee by providing as much solid information as there is available.

4. Spectro Alloy needs to make better use of available resources. The gathering and sharing of information can be augmented by using organizations with which Spectro Alloys already belongs. Examples are: The Institute of Scrap Recyclers, North American Die Casting Association, American Society of Safety Engineers, and The Minnesota Safety Council. The University of Minnesota Library System is less than twenty miles away. The Internet is always available, and organizations like The Chlorine Institute and The Aluminum Association have many resources available. Minnesota OSHA is also a very good organization to use when there are questions related to health hazards and employee exposure.

5. As a form of future assessment, formal surveys to assess trust should be purchased or created. A questionnaire or survey should be used periodically to measure the trust levels at Spectro Alloys. A baseline should be established in order to assess the effectiveness of the management system’s efforts in this area.

6. The NIOSH Health Hazard Evaluation program needs to be examined thoroughly by Spectro’s upper management. Having a governmental agency come to Spectro for the purpose of gathering and sharing information may be a positive way for trust-building to be incorporated. Years of mistrust will initially make it difficult for people inside Spectro to build trust. Having a credible outside source come in to gather and share information may be a great impetus to start the program.

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